Chapter 6. Biological Resources

6.1. Biological Resources

This section provides information on biological resources located in the central coast study region. Federal, state, and local laws, policies, and regulations that influence biological resources are also discussed. Impacts on biological resources that may result from the Proposed Project are identified, as well as mitigation measures to avoid, minimize, or compensate for potential significant impacts, where appropriate.

6.1.1. Environmental Setting

6.1.1.1. Benthic and Shoreline Habitats

The central coast supports a wide variety of habitats for marine life, including the muddy bottoms deep in marine canyons, rocky nearshore reefs with kelp forests, sandy beaches, estuarine eelgrass beds, and open waters. Rocky shores and sandy beaches dominate the shoreline; marsh and tidal flat habitats are rare on the central coast (Table 6.1-1). In addition, the central coast study region intertidal habitat has a higher percentage of rocky shores and sandy beaches and a lower percentage of coastal marsh and tidal flats than the rest of the state. The major habitats found in the study region are described below, proceeding from land to deepwater. Habitats found within the central coast study region are illustrated in Figures 6.1-1a to 6.1-1g.

Table 6.1-1. Existing Habitat Representation in Central Coast Study Region

Habitat	Measure	Amount
Intertidal		
Sandy or gravel beaches	Linear (mi)	223.66
Rocky intertidal and cliff	Linear (mi)	209.21
Coastal marsh	Linear (mi)	36.53
Tidal flats	Linear (mi)	23.48
Surfgrass (linear miles)	Linear (mi)	161.09
Eelgrass	Area (mi^2)	1.07
Estuary	Area (mi^2)	9.83
Soft Bottom		
0–30 meters	Area (mi^2)	270.34
30–100 meters	Area (mi^2)	562.38
100–200 meters	Area (mi^2)	57.83
>200 meters	Area (mi^2)	105.52
Hard Bottom		
0–30 meters	Area (mi^2)	73.60

Habitat	Measure	Amount
30–100 meters	Area (mi^2)	40.30
100–200 meters	Area (mi^2)	14.64
>200 meters	Area (mi^2)	16.16
Kelp Forest		
Average kelp (‘89, ‘99, ‘02, ‘03)	Area (mi^2)	10.83
Persistent kelp	Area (mi^2); present in 3 of 4 yrs	3.18
Submarine Canyon		
0–30 meters	Area (mi^2)	0.56
30–100 meters	Area (mi^2)	4.42
100–200 meters	Area (mi^2)	6.06
>200 meters	Area (mi^2)	42.77

Source: CDFG 2005a.

Intertidal Zones

The intertidal zone is defined as a transition zone between marine and terrestrial environments that includes many important ecosystems and biological communities. The intertidal biological communities of the central California coast are notable for their diversity and abundance. Intertidal zones along the central California coast can be classified as rocky shore, sand and gravel beaches, tidal flat, coastal marsh, seagrass beds, and estuaries.

Rocky Shore

Rocky shore habitats and their associated ecological assemblages are found throughout the central coast study region, although they are absent in significant stretches of the coast in certain areas. Rocky intertidal communities, from the splash zone (the upper extent of the intertidal zone) to the lower intertidal zone, vary in composition and structure with tidal height and wave exposure. Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many hundreds of species of algae, fishes, and invertebrates, including barnacles, anemones, snails, mussels, crabs, and sea stars. Mussel beds, sea palm, algal beds, and surfgrass are patchily distributed along rocky shores but support a very diverse fauna. In addition to the tidal height and steepness of the shore, the underlying geology of a rocky coast can affect the ecological communities present. The most prominent of the shoreline types are listed below (CDFG 2005a):

- **Exposed Rocky Cliff:** This shoreline type is characterized by a steep, narrow intertidal zone (more than 30° slope) and little sediment accumulation. It also has strong vertical zonation of intertidal communities; barnacles, mussels, limpets, sea stars, anemones, crabs, and macroalgae are abundant.

- **Exposed Wave Cut Rocky Platform:** This shoreline type includes flat rocky benches of variable width with irregular surface and tidepools. The shore may be backed by a scarp or bluff with sediments or boulders at its base. Some sediment accumulation occurs in pools and crevices. This habitat supports rich tidepool and intertidal communities with algae, sponges, anemones, barnacles, snails, mussels, sea stars, brittle stars, bryzoans, tunicates, crabs, isopods, amphipods, and polychaetes.

- **Sheltered Rocky Shore:** This shoreline type includes bedrock shores of variable slope (cliffs to ledges) that are sheltered from wave exposure. This habitat supports rich tidepool and intertidal communities with algae, sponges, anemones, barnacles, snails, mussels, sea stars, brittle stars, bryzoans, tunicates, crabs, isopods, amphipods and polychaetes. Sheltered rocky shores occur in the study region but are very rare, typically found inside bays or estuaries.

Sand and Gravel Beach

Within the central coast study region, significant expanses of continuous sandy shore occur along Monterey, Estero, and San Luis Obispo Bays, with shorter stretches of sandy beaches and pocket beaches along the Big Sur coast. Sandy beach communities are structured in large part by grain size, beach slope, and wave energy. Beaches are dynamic systems that change with wind and waves; generally, sand is eroded from beaches in winter and redeposited in summer, resulting in annual changes in beach slope and width. Barrier beaches and sand spits form at the mouths of larger rivers. Small pocket beaches occur where rocky cliffs are eroded along exposed coasts. Rivers deposit sediments and create barrier beaches and sandspits, such as those at the mouths of the Salinas, Pajaro, and Santa Maria Rivers. A variety of invertebrates live in the sand and in wracks of decaying seaweed and other detritus on the sand surface. There are numerous species of shorebirds, such as sanderlings, marbled godwits, and willets, which feed at the water's edge. Western snowy plovers and California least terns nest on sandy beaches and coastal dunes. Marine mammals haul out on isolated beaches and sands spits. Sand dollars, worms, clams, crabs, surfperches, flatfishes, and other fishes live in the surf zone. Beach types in the central coast study region have been mapped as linear shoreline features and classified based on grain size, as described below (CDFG 2005a):

- **Gravel Beach**: This beach is composed of sediments ranging from pebbles to boulders and are often steep with wave-built berms. Attached algae, mussels, and barnacles are found on lower stable substrata.

- **Mixed Sand and Gravel Beach**: This beach is moderately sloping with a mix of sand and gravel. There may be zones of pure sand, pebbles, or cobbles.

Sand fraction may get transported offshore. More stable substrata support algae, mussels, and barnacles.

- **Coarse-Grained Sand Beach**: This beach is moderate to steep with variable width and soft sediments, typically at river mouths. It may be backed by dunes or cliffs. Fauna is scarce.

- **Fine- to Medium-Grained Sand Beach**: This beach is flat, wide, and hard-packed, and there are significant seasonal changes in width and slope. Upper beach fauna is scarce; lower beach fauna includes sand crabs, polychaete worms, and amphipods. These beaches are the most common type in central California. Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g. Elkhorn Slough and Morro Bay). Tidal flats are sandy or muddy expanses that are exposed at low tides and provide important foraging ground for shorebirds because of the abundance of invertebrates such as clams, snails, crabs, and worms. High densities of sandpipers, willets, yellowlegs, and avocets can be found on tidal flats at low tide. Herons and egrets also forage at the water's edge. At high tide, tidal flats become important foraging habitat for estuarine fish (e.g., sculpins, sanddabs, California halibut, leopard sharks). Coastal marshes support high levels of productivity and provide habitat for many species. Marshes also regulate the amount of freshwater, nutrient, and sediment inputs into the estuaries and play an important role in estuarine water quality. The position of marshes along estuarine margins and their dense stands of persistent plants also make them essential for stabilizing shorelines and storing floodwaters during coastal storms. Vegetation patterns and dominant species in coastal brackish marshes vary with the salinity regime that is defined by precipitation patterns and changes in freshwater inputs.

Shoreline Types

The following shoreline types have been mapped as linear features of the central coast study region coastline (CDFG 2005a):

Coastal Marsh

These include intertidal areas with emergent vegetation, either salt marsh or brackish marsh. The width of marsh varies from a narrow fringe to extensive areas. Coastal marshes provide important habitat for a variety of species.

Exposed Tidal Flats

These include intertidal flats composed of sand and mud. The presence of some wave exposure generally results in a higher presence of sand than in sheltered tidal flats; this occurs in bays and lower sections of rivers. Sediments in tidal flats are generally water-saturated with the presence of an infaunal community that attracts foraging shorebirds. Exposed tidal flats are used as a roosting site for birds and haul-out site for marine mammals. This habitat is very rare in central California.

Sheltered Tidal Flats

These include intertidal flats comprised of silt and clay (e.g., mudflats). They are present in calm water habitats and sheltered from wave exposure, and are frequently bordered by marsh. Soft sediments support large populations of worms, clams, and snails. Sheltered tidal flats are an important foraging area for migrating shorebirds.

Estuaries

Estuaries, where freshwater and saltwater meet in the mouths of streams and rivers, are very limited, but nonetheless important, habitats in the central coast study region. Because of the Mediterranean climate in central California, with winter-spring storms and southeast winds, and the long dry summer-fall season with prevailing northwesterly winds, estuaries are quite variable in temperature and, especially, salinity. Winter high water flows and warm summers produce large changes in water conditions and the biota of estuaries are adapted to these conditions. For the tolerant species that can use them, the abundant organic matter and extensive plant habitats in estuaries provide unique and productive habitats. Generally, salinities in central coast estuaries are around 25 parts per thousand because of relatively low freshwater inputs in the region, but can freshen substantially in winter. Lagoons are coastal water bodies that are cut off from the sea and generally have low freshwater inputs. California's estuaries contain open water and soft-bottom habitats, as well as special habitats described later, such as coastal marsh, tidal flats, and eelgrass beds (CDFG 2005a).

The central coast study area includes two relatively large permanent estuaries, Elkhorn Slough and Morro Bay, and many small estuaries or lagoons at the mouths of coastal rivers: San Lorenzo, Pajaro, Salinas, Carmel, Little Sur, Big Sur, Arroyo de la Cruz, Santa Ynez, and many others. The aerial extent of estuaries in the central coast study region totals only 6.9 nm^2. Coastal bays and estuaries in the region (especially Monterey Bay/Elkhorn Slough and Morro Bay) are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. Anadromous fish (e.g., salmonids) pass through estuaries on their migrations. Steelhead in the central coast spend a significant part of their juvenile phase in coastal estuaries. Because estuaries and lagoons are important habitat linkages between marine, aquatic and terrestrial habitats, their condition is closely tied to the condition of the surrounding watershed. Estuaries provide critical ecosystem services such as filtering sediments and nutrients from the watershed, stabilizing shorelines, and providing flood and storm protection (CDFG 2005a).

The Elkhorn Slough estuary has diverse habitats, combining the marshes of Elkhorn Slough and Moro Cojo Slough, the largest between San Francisco and Morro Bays at approximately 6.23 square miles. The estuary contains a variety of habitats: tidal sloughs, mudflats, and salt and brackish marshes. Elkhorn Slough is home to more than 270 species of resident and migratory birds. This estuary provides important feeding and roosting habitat for a variety of migrant and resident birds, including two heron rookeries, a small breeding population of western snowy plovers, nesting pairs of golden eagles, white-tailed kites, and other raptors. Elkhorn Slough also serves as an important fish nursery and fish habitat. The estuary functions as a filter and sponge for sediment and pollution from agriculture and other uses of the watershed. The entrance of Elkhorn Slough is aligned with the head of the Monterey Submarine Canyon (CDFG 2005a).

The Morro Bay estuary encompasses approximately 3.6 square miles of mudflats, open-water habitat, and tidal wetlands. This estuary supports a unique ecosystem containing numerous plants and animals and habitats including open water and channels, subtidal and intertidal eelgrass beds, mudflats, coastal salt marsh, brackish marsh, freshwater marsh, and riparian woodland. These habitats support a number of special status species. Morro Bay is a significant estuarine nursery area, particularly for flatfishes (CDFG 2005a).

Seagrass Beds

Seagrass beds are very productive and biologically diverse habitats. They occur in estuaries, bays, and in portions of the open exposed coast. The most common type of seagrass in estuaries and sheltered coastal bays in California is eelgrass (*Zostera marina*) (Abbott and Hollenberg 1976). It is a flowering plant, not an alga, and occurs in dense beds, which stabilize near shore sediments through its spreading rhizomes and by slowing water flow. Eelgrass beds provide foraging, breeding, or nursery areas for invertebrates, fish, and birds. They provides structure in the subtidal that attracts fish (CDFG 2005a).

Eelgrass beds, mapped in Morro Bay by the Morro Bay National Estuary Program and in Elkhorn Slough by the Elkhorn Slough National Estuarine Research Reserve, cover a very small portion of the study region. Total coverage of eelgrass beds in Morro Bay is approximately) and 0.8 nm^2, and coverage in Elkhorn Slough is 0.025 nm^2 (Figures 6.1-1a to 6.1-1g). There is an extensive seagrass bed on the shale reef off Del Monte Beach, Monterey, but the current condition of this bed is not known and it has not been mapped (CDFG 2005a).

The eelgrass beds in Morro Bay are the largest and least impacted of any in central and southern California. These unique beds are productive and complex environments. The beds serve as spawning and nursery grounds for many species of fish, including English sole (*Parophrys vetulus*) and California halibut (*Paralichthys californicus*). The density and diversity of benthic fauna are several times greater within the eelgrass beds than in other Morro Bay habitats. A vital community of epiphytic flora and fauna lives on the blades composing the thick foliage of the beds (CDFG 2005a).

The most common type of seagrass along the open coast is surfgrass (*Phyllospadix* spp.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero tide level down to several meters below the zero tide level. In some areas, such as Soquel Point, Santa Cruz County, surfgrass forms extensive beds. The distribution of surfgrass along the central coast study region has been mapped as linear segments that total 141 nm, or 38% of the shoreline (CDFG 2005a).

Kelp Forests

Kelp forests are critical habitats for many marine species in inshore areas of central California and are essential to maintain the diversity and abundance of marine life. The spectacular giant-kelp forests of California occur nowhere else in the world. Kelp forests (or kelp beds) are formed by two predominant canopy-forming, brown, macroalgae species in central California: giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nereocystis lutkeana*). These two types of kelp forests differ in their biological productivity (giant-kelp forests are more productive) and species assemblages, and should be considered separate habitats (CDFG 2005a). Kelp beds are quasipermanent features, but the extent of their canopies changes seasonally and annually in response to seasonal growing conditions, winter storm activity, and oceanographic conditions such as El Niño events (Ebling et al. 1985; Harrold et al. 1988; Zimmerman and Robertson 1985).

Kelp beds grow along much of the central coast study region on nearshore hard substrate. In general, beds can extend to a maximum depth of about 30 meters (m), or near 90 feet (ft). Extensive kelp beds are found in many areas of the central coast, such as Point Sur and Lopez Point. The kelp forests in central California were well mapped at fine-scale resolution in 1989, 1999, 2002, and 2003 by aerial surveys carried out by the Department. Kelp canopy extent averaged 10.83 square miles over the survey period; in some years, the central coast study region had almost half of the total statewide kelp bed extent. In 2003, there were 7.2 square miles of kelp bed in the central coast study region (Figures 6.1-1a to 6.1-1g) (CDFG 2005a).

Kelp forests are one of the most productive marine habitats along the coast of California and provide habitat and nursery areas for many species of fishes and invertebrates. Kelp forests, dominated by giant kelp (*Macrocystis pyrifera*), occur from Baja California (Mexico) up through central California (approximately Sand Hill Bluff area near Davenport, Santa Cruz County) in nearshore waters with hard substrata where the kelp can attach. North of Davenport, bull kelp (*Nereocystis luetkeana*) becomes the dominant kelp. These two types of kelp beds harbor distinct ecological assemblages. In many parts of the central coast, especially areas exposed to greater wave action, mixed beds of giant kelp and bull kelp are found. Kelp beds are characterized by a high degree of spatial and temporal variability. Studies have shown that distribution and abundance of kelp beds and successional processes are affected by climatic and oceanographic changes, abundance of urchins and other grazers, and certain types of fisheries (CDFG 2005a).

Kelp beds are important habitat and feeding grounds for many species. Juveniles of many nearshore rockfish species, as well as juvenile bocaccio and yellowtail rockfish, occur in the midwater kelp canopy (Allen et al. in press). Juveniles and adults of many nearshore rockfish species, as well as cabezon, greenlings, lingcod, and many other species, associate with bottom habitats in kelp forests (Allen et al. in press). The sea otter occurs throughout the study region and is considered a keystone species for its role in structuring kelp forest communities by preying on sea urchins and other macroinvertebrates, including other herbivores (CDFG 2005a).

Sandy and Soft Bottoms

Most of the seafloor in the central coast study region is composed of unconsolidated sediments; therefore, soft bottom habitats are found in estuaries, along sand beaches, and on the continental shelf and slope throughout the region. The continental shelf and slope environments include soft-bottom habitats in areas that range from flat expanses to slopes to deep submarine canyons. Soft-bottom habitats lack the structural complexity and relief of hard-bottom substrata, but they support hundreds of species of bottom-dwelling invertebrates and fishes. These assemblages differ mainly with depth and sediment-grain sizes and supply of organic matter. Sediments recycle organic matter, replenish nutrients, and are sites of invertebrate production and trophic transfer within coastal ecosystems (CDFG 2005a).

Soft-bottom habitats can be highly dynamic in nature as sediments shift because of wave action, bottom currents, and geological processes. Many parts of the Big Sur coast are erosional, and landslides and slumps extend offshore in the nearshore waters. Many canyon heads are also alluvial in nature and dominated by shifting soft sediments. Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70 to 230 m, especially in areas where the shelf is wide and riverine input is present. Soft-bottom habitats in different depth zones should be considered separate habitats (CDFG 2005a).

Soft-bottom habitats are primary habitat for soles, turbots, halibut, sanddabs, flounders, and shrimp. Squid spawning grounds occur in many of the nearshore sandy bottoms of the central coast study region; major spawning grounds occur in Monterey Bay and the San Luis Obispo Bay area (CDFG 2005a).

Rocky Substrate

All hard-bottom substrata are included as “rocky reefs.” Although this habitat overlaps with the kelp forest habitat in waters less than about 90 ft, it includes significant amounts in deeper waters.

A complete characterization of the extent of this important habitat type is not yet available, but efforts are underway to increase the mapped area of the central California seafloor. Rocky reefs within the study region are well known to commercial and recreational fishermen, as well as other mariners and researchers. There are hundreds, possibly thousands, of species associated with hard substrates along the central coast. The species that associate with hard substrata differ greatly with depth and type of substratum (Cross and Allen 1993). Rocky substrata are much less common than soft substrata in the region at all depth zones, but they provide hard substrata to which kelp and other alga can attach in the nearshore (less than 30 m in depth). In addition, many invertebrates such as deep-sea corals, sponges, and anemones require hard substrate for attachment and are found only on hard substrata in deeper waters (Engle and Coyer 1981). In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. The fauna of rocky reefs differs by depth zone and substratum type (i.e., the amount of relief changes with gravel, cobble, boulders, and smooth rock outcrop). Therefore, rocky reefs in each depth zone should be considered separate habitats (CDFG 2005a).

The ecological assemblages associated with rocky habitats can also be influenced by the type of rock (e.g., sedimentary vs. granitic reefs) or size of substrata (e.g., cobble vs. boulder). A unique natural feature of the central coast study region is an expanse of granitic outcrops in state waters from southern Monterey Bay (Point Pinos) to Point Sur. The region extending from the northern half of Monterey Bay north to Pigeon Point is characterized by sandstone and shale beds. South of Point Sur, the Franciscan Complex dominates (greenstone, serpentinite, argillite, and greywacke). Rocky reefs in each of these geologically distinct zones should be considered separate habitats (CDFG 2005a).

Vertical rocky pinnacles up to tens of meters in diameter and height with a cone-shaped geometry also occur in the central coast study region. Pinnacles can be distinguished from large boulders by their geologic origin. Pinnacles are produced by erosion in other locations, and the resulting large rocks are moved into the region by geological processes. Pinnacles are scattered along the entire Big Sur coast and attract certain fish and invertebrate species. Pinnacles have been provisionally identified using bathymetric and fine-scale substratum data in a geographic information systems (GIS) analysis for area where fine-scale mapping is available; their area of pinnacle coverage cannot be calculated until seafloor mapping is complete (CDFG 2005a).

Submarine Canyons

There are several large submarine canyons in the central coast study region. The Monterey Submarine Canyon is the largest of these and the most prominent topographical feature on central California’s shelf and slope. A significant portion of this canyon is contained within the study region. Soquel Canyon is an extension to the north of the main channel of the Monterey Submarine Canyon. Carmel Canyon, extending seaward from the mouth of the Carmel River, is a southern extension of the Monterey Submarine Canyon complex. The upper reaches of Partington Canyon, approximately 12 miles south of Point Sur, bring deep-water habitats close to shore along the Big Sur coast. Mill Creek Canyon is another large canyon offshore of the Big Sur coast. In addition, there are smaller canyons with their heads in state waters in the northern half of the study region. Canyons in state waters are rare, and the central coast study region has more canyons than other parts of the state. Of the 70 square miles of canyons mapped to date in state waters, 41 square miles are in the central coast study region (CDFG 2005a).

Submarine canyons are bathymetrically complex, support deep-water communities close to shore, and affect local and regional circulation patterns. The south side of Monterey Canyon is very productive because prey organisms migrate up from the canyon depths to feed and are transported by currents southward to be trapped in shallow shelf waters, where they are then preyed on by fish, birds, and marine mammals. In addition to the canyons themselves, the canyon heads that occur in nearshore water are considered areas of high biodiversity because of the presence of a steep elevation gradient, variation in benthic topography, and other factors that support biological richness. Canyon heads vary in their structure from steep rocky relief to flat alluvial forms. Steep and rocky canyon walls provide shelter for many species of benthic fishes, including rockfishes and thornyheads; sedimentary canyon heads provide habitat for animals such as flatfishes (CDFG 2005a).

6.1.1.2. Pelagic and Neritic Habitats

Pelagic and neritic habitats comprise the surface waters to about 200 m in depth. Certain oceanographic features in them are important habitats for the region because those features are where most of the primary production and much of the energy transfer that supports the marine ecosystem occurs. Sunlight from above and nutrients from deep water combine in the surface layers to provide conditions for variable but seasonally high rates of phytoplankton growth. The fixed carbon is passed onto other larger consumers in the complex coastal food web and, in conjunction with contributions from attached benthic algae, ultimately supports the higher trophic levels: forage fishes, large fishes, seabirds, turtles, and marine mammals (CDFG 2005a).

Although they are highly complex and dynamic, some oceanographic features are relatively predictable or persistent and are important habitats. Along the central California coast, the main currents are the southward-flowing, relatively cold-water California Current and the subsurface northward-flowing, relatively warmer-water Davidson Current. The flow of the California Current is reduced in winter, and the Davidson Current becomes the dominant large current. These currents converge at Point Conception, creating a major biogeographic boundary that many species do not cross. North of Point Conception, the countercurrent may surface as a nearshore northward flowing current, especially in fall and winter. Ocean circulation patterns are affected by winds, ocean temperatures and salinities, tides, coastal topography, and ocean-bottom features (CDFG 2005a).

The central coast study region is characterized by three “seasons” driven largely by oceanographic conditions. The seasons are the upwelling season, wind relaxation period, and winter storm period. Upwelling of cold, nutrient-rich waters occurs in early spring and summer and generally peaks in May and June; however, there is significant variability in upwelling among years and with latitude. Upwelling is also associated with coastal features such as headlands and bathymetric features such as the shelf-slope break and offshore banks (CDFG 2005a).

The California Current is also characterized by highly variable oceanographic conditions. The ENSO is a large-scale change in atmospheric pressure, trade winds, and sea surface temperatures (SSTs) of the tropical Pacific Ocean that occurs every few years and has significant effects on the California Current system. During ENSO events, there is a reduction in upwelling of cold, nutrient-rich waters, increased onshore and northward flow, increased SST, and increased northward advection of warm, subtropical waters. ENSO events generally result in a decline in zooplankton and reductions in productivity that can affect fish, seabird, and marine mammal populations. Longer-term decadal and multidecadal climatic cycles also affect a wide variety of marine organisms. Changes in atmospheric circulation in the central and northern Pacific Ocean and other factors yet unknown result in shifts in mean SST every 20 to 30 years that have large-scale impacts on zooplankton and fish productivity throughout the region. Most of what is known of the effects of these climatic regime shifts (called Pacific Decadal Oscillations) is recent information (CDFG 2005a).

Nearshore current patterns are variable, but some features appear regularly and persist for some time. For example, in Monterey Bay, there is a counterclockwise circulation, which is typical of the region during upwelling-favorable wind conditions (CDFG 2005a).

Oceanographic processes such as currents, water masses, and temperature influence marine biodiversity. Variation in factors such as water temperature, upwelling, and currents determine areas of productivity where krill, squid, anchovy and other pelagic finfish, seabirds, and marine mammals congregate in the pelagic ecosystem. In addition, oceanographic processes and cross-shelf transport can significantly affect recruitment patterns of fish and invertebrates in intertidal and nearshore communities. The importance of these processes and their predictability is leading to more emphasis on identifying persistent oceanographic features, such as upwelling areas, retention areas, and freshwater plumes as important influences on regional productivity, recruitment patterns, and movement and distribution of many species. These features are very dynamic; some examples are provided below (CDFG 2005a):

Upwelling Zones

The central coast study region has three of the six major upwelling centers in California. Major upwelling cells during the upwelling season are typically found at Davenport (Santa Cruz County), Point Sur, and Point Conception. In addition, there is often upwelling along the Big Sur coast. Large upwelling zones often result in the generation of offshore jets and squirts, where surface waters are carried tens to hundreds of kilometers offshore. Upwelling events typically last days or weeks (CDFG 2005a).

Retention Areas

Longshore coastal currents interact with headlands or other coastal features, causing the formation of headland eddies, or upwelling shadows, on the lee side of headlands, especially where embayments occur. These eddies and upwelling shadows increase the retention (or reduce the dispersion) of planktonic organisms, and areas where they occur are considered retention areas. Even small embayments in the lee of small headlands can be localized retention zones (CDFG 2005a).

River Plumes

Freshwater flowing out of larger coastal rivers is lighter and warmer than the continental shelf waters and is visible as a distinct plume. In the region, coastal rivers and streams introduce freshwater, sediment, nutrients, and pollutants into localized nearshore waters. Although they are typically localized in impact, these plumes can reach hundreds of kilometers offshore following El Niño or other large storm events. These plumes can significantly affect the early life stages of invertebrate organisms and can induce settlement of some species, so they may play an important role in dispersal of some species and enable linkages between habitat patches in the area. Large rivers in the region, including the Salinas, Santa Maria, and Santa Ynez Rivers, may have relatively large plumes especially during the winter rainy season (CDFG 2005a).

6.1.1.3. Areas of Significant Biodiversity

Spatial data are available to begin identifying specific locations in the study region that have high biodiversity significance based on the guidelines provided in the master plan framework (CDFG 2005a) and results of regional scientific research and mapping efforts. A partial list of types of areas that have regional biodiversity significance is provided below:

- areas where numerous habitats are found in close proximity and areas with unique combinations of habitats;
- large estuaries (Elkhorn Slough and Morro Bay) with eelgrass beds, tidal flats, and coastal marsh;
- small estuaries with presence of coho salmon or steelhead populations;
- submarine canyon heads and large submarine canyons, including those that are either soft or hard substrate–dominated;
- marine areas off headlands with adjacent upwelling centers, especially those with kelp forests and rocky reefs in retention areas in the lee of the upwelling center;
- persistent kelp beds and nearshore rocky reefs;
- areas of high bathymetric complexity that provide topographic relief and a variety of habitats in close proximity;

- shallow and deep pinnacles where fish aggregate;
- rocky substrates in all depth zones because rocky habitat is more rare than soft-bottom habitat;
- shelf-slope break (100 to 200 m) where the continental shelf slopes downward (an area with high biodiversity);
- rocky intertidal shores, especially wave-cut rocky platforms, which provide habitat at diverse tidal elevations, and rare sheltered rocky shores;
- seabird colonies and marine mammal rookeries and haul-outs; and
- areas of high fish or seabird diversity or density as identified by NOAA Fisheries.

6.1.1.4. Species of Special Concern

Some fish, marine mammals, and seabirds of the central coast region whose populations have declined receive special protections under the federal and California Endangered Species Acts (ESA and CESA). In addition, marine mammals are protected under the MMPA, and migratory seabirds and shorebirds in the study region are protected under the Migratory Bird Treaty Act (MBTA). These acts are summarized below in section 6.2. A list of special-status species expected to occur in the region was compiled by the MBNMS and is provided in Appendix E. Brief descriptions of selected species are provided below.

Coho Salmon

The central California coast coho salmon (*Oncorhynchus kisutch*) DPS occurs in the study region and is listed as threatened under the federal ESA (Figure 6.1-2a and 6.1-2b). In the study region, there are five coastal rivers or streams that support populations of coho salmon: Gazos Creek, Waddell Creek, San Vicente Creek, San Lorenzo River, and Scott Creek (Adams et al. 1999). The Scott Creek population in the Big Basin hydrologic unit is considered a key population to maintain or improve (CDFG 2004).

Steelhead

There are three steelhead (*O. mykiss*) DPSs in the central coast study region with federal status under the ESA (Figures 6.1-2a and 6.1-2b). The central California coast steelhead DPS ranges extends from north of San Francisco Bay (Russian River watershed) to the Santa Cruz area (just below Aptos Creek) and is listed as threatened. The south-central California coast steelhead DPS extends from the Pajaro River Basin north of Monterey to the Santa Maria River and is listed as threatened. The southern California steelhead DPS, listed as endangered, extends from the Santa Maria River to beyond the study region's southern boundary. There are at least 47 coastal streams or rivers that currently support steelhead in the study region (CDFG 2005a).

Sea Otters

Once ranging from northern California to Punta Abreojos in Baja California Sur with few exceptions, southern sea otters (*Enhydra lutris*) are now found from Point Año Nuevo in San Mateo County south to Purisima Point in Santa Barbara County, and occasionally as far north as Half Moon Bay and as far south as Santa Barbara. Historically, sea otters numbered approximately 15,000 in California, but commercial hunting severely reduced their population in the 18th and 19th centuries. By 1914, the California population of sea otters may have numbered as few as 50 animals. Between 1983 and 1994, the sea otter population grew at an average annual rate of 5% to 6%, and included a multi-year decline in the 1990s. The population reached a maximum observed population size of 2825 individuals in the spring of 2004, with the 2005 and 2006 counts down slightly. Although recent estimates indicate that the population is growing, recovery is still constrained by a variety of factors that contribute to otter mortality, including incidental drowning in trammel nets, exposure to oil spills and toxic contaminants, other human impacts, and disease (CDFG 2005a). The most recent statewide population count is 2,692 for the spring of 2006 based on surveys by the U.S. Geological Survey (USGS) (2006), although the 3-year running average of 2,751 is a more reliable indication of population size. This is well below their historic statewide abundance, and sea otters are still listed as federally threatened. Their current distribution includes almost the entire central coast study region's nearshore waters.

Sea otters are a keystone species,[1] exerting strong top-down control on their prey species, that can initiate trophic cascades.[2] Their predation limits urchin abundance, allowing for the growth of kelp forests and associated species. Sea otters have a varied diet consisting of benthic invertebrates such as red sea urchins (*Strongylocentrotus franciscanus*), red abalone (*Haliotis rufescens*), black abalone (*H. cracherodii*), kelp crabs (*Pugettia producta*), clams (e.g., Pismo clam [*Tivela stultorum*]), and cancrid crabs (*Cancer* spp.) (Ostfeld 1982). Sea otters use many nearshore habitats along the coast, from estuaries to kelp forests and rocky habitats. Typically, sea otters are found nearshore but sometimes as much as 10 kilometers from shore (CDFG 2005a). Mapped data on the density of otters in linear segments along the central coast have been compiled and are shown in Figures 6.1-2a and 6.1-2b.

Expansion of sea otter populations following protection from harvest resulted in conflicts with commercial and recreational abalone fisheries that had developed when otter numbers were depressed and abalone were abundant (Estes and VanBlaricom

[1] A *keystone species* has a disproportionate effect on its environment relative to its abundance. Such an organism plays a role in its ecosystem that is analogous to the role of a keystone in an arch.

[2] A *trophic cascade* occurs when removal of a top predator causes a change in its prey and ultimately in the abundance of plants because of changes in the herbivore populations. For example, in a reef system, removal of large predatory fish species has resulted in increases of algae in the ecosystem.

1985). In some locations in northern California, predation by otters may have a larger effect on red abalone populations than current human harvest rates (CDFG 2005a).

Pinnipeds

Like sea otters, pinnipeds were hunted to very low levels during the 19th century. California sea lion and harbor seal populations are recovering. Four species of pinnipeds have either colonial rookeries or haul-out sites in the central coast study region based on data collected and compiled by NOAA (CDFG 2005a)(Figures 6.1-2a and 6.1-2b). Little information on historical abundances is available for California sea lions and harbor seals, although some early estimates were included for comparison with later systematic censuses.

California Sea Lion

The range of the California sea lion (*Zalophus californianus*) extends from the Pacific coast of southern British Columbia to Baja California. These animals breed primarily in the southern part of their range from the Gulf of California to San Miguel Island, in the southern California Bight. Commercial hunting in the 19th and early 20th centuries likely reduced California sea lion populations. In the late 1920s, only 1,000 to 1,500 California sea lions were counted on the shores of California. Since a general moratorium on hunting marine mammals was imposed with passage of the MMPA in 1972, the population has grown substantially to a current estimate of 237,000 to 244,000 animals. Between 1975 and 2001, the population grew at an average annual rate of 5.4%.

California sea lions are opportunistic feeders on a variety of prey, especially seasonally abundant schooling species such as Pacific hake, northern anchovy, Pacific sardine, spiny dogfish, and squid. They tend to feed in cool upwelling waters of the continental shelf. In a recent study at Año Nuevo Island, sea lions were found to feed on rockfishes, Pacific whiting, market squid, Pacific sardine, northern anchovy, spiny dogfish, and salmonids. Based on their research, Weise and Harvey (2005) estimated sea lions in central California consumed 8,406 to 8,447 tons of prey species over a 1-year period in 2001–2002 at Año Nuevo Island, of which 450 to 1,525 tons were salmonids. A study in southern California found that market squid were determined to be the most important prey type (CDFG 2005a). California sea lions frequently consume fish, particularly salmon, hooked by recreational and commercial fishermen. Losses to these fisheries from sea lion predation can be significant.

Steller Sea Lion

Central California is the southern extent of the range of the Steller sea lion (*Eumatopias jubatus*), also known as the northern sea lion. The diet of Steller sea lions is dominated by a variety of fish, especially demersal groundfish, and squid (CDFG 2005a).

Northern Elephant Seal

The northern elephant seal (*Mirounga angustirostris*) was hunted almost to extinction by the late 1800s. Today, there are breeding colonies at Año Nuevo Island, Point Año Nuevo, Piedras Blancas, and Cape San Martin. Squid dominates the diet of northern elephant seals (CDFG 2005a).

Harbor Seal

Harbor seals (*Phoca vitulina*) are widely distributed in the coastal areas of the northern Pacific and northern Atlantic Oceans. Harbor seals in the eastern Pacific Ocean range from the Pribilof Islands in Alaska to Isla San Martin off Baja California. Between the Mexican and Canadian borders with the U.S., harbor seals have been managed as three separate stocks, one of which is the stock off California. After passage of the MMPA in 1972, harbor-seal abundance grew rapidly until 1990, when stocks leveled off. There has been no net population growth in California since 1990. In 2002, the population was estimated at 27,863 animals (CDFG 2005a).

Although they are not colonial, harbor seals are gregarious while molting and resting, and they haul out in groups on sandbars and rock ledges along the central coast. Harbor seals eat a wide variety of pelagic and benthic prey, including small schooling fishes such as northern anchovy, many species of flatfishes, bivalves, and cephalopods. In a southern California study, harbor seals were found to mostly eat rockfish, octopus, spotted cusk-eel, and plain midshipman. Diet studies of harbor seals in central California did not find evidence of predation on salmonids, although they are known to eat small salmonids in northern California (CDFG 2005a).

Cetaceans

The entire California coast is part of the annual gray-whale migration route, and gray whales can be observed from shore. Harbor porpoises and bottlenose dolphins are relatively common in nearshore waters. Several species of whales (blue, gray, humpback, killer, and fin) can be seen seasonally in the Monterey Bay area and throughout the central coast study region (CDFG 2005a).

Seabird Colonies

The region supports a diverse assemblage of seabirds, many of which aggregate into colonies, especially during the breeding season. Prey resources are often abundant because of the high productivity of the California Current, and there are numerous cliffs, offshore rocks, and islands for roosting and nesting habitat. Most of the rocks and islets along the coast are protected in the California Coastal National Monument, managed by the U.S. Bureau of Land Management. Millions of seabirds migrate through or breed in the region annually. Many populations of seabirds in the region are sensitive to changes in oceanographic conditions, with reproductive success and population size fluctuating with changes in food availability associated with warm- and cold-water events.

Upwelling areas, persistent fronts, the shelf-slope break, and Monterey Bay are all important foraging areas for seabirds in the region. Some important breeding sites include Año Nuevo Island and numerous offshore rocks and pinnacles along the central California coast. Some seabird species with colonies in the central coast study region include common murres, pigeon guillemot, least tern, black oystercatcher, pelagic cormorant, and Brandt's cormorant. Seabird colony locations in the central coast study region are shown on Figures 6.1-2a and 6.1-2b, based on data compiled by the USFWS of high seabird diversity and density (top 20th percentile). A synthesis of data compiled by the NOAA Biogeographic Assessment of the region also are shown on Figures 6.1-2a and 6.1-2b (CDFG 2005a).

There are 28 birds on the list of federal and state special-status species present in the MBNMS (Appendix E). Many depend on coastal beaches, estuaries, and nearshore marine environments (CDFG 2005a).

6.1.1.5. Species of Economic Interest

Species of economic interest include spot prawn; nearshore finfishes such as rockfishes, cabezon, and kelp greenling; salmon; market squid; flatfishes; Dungeness crab; lingcod; sablefish; coastal pelagic finfishes such as sardine, mackerel, and anchovy; albacore; and kelp. A discussion of economically important fisheries can be found in Chapter 4.

6.1.1.6. Species Likely to Benefit from MPAs

The MLPA requires that species that are likely to benefit from MPAs be identified because the identification of such species contributes to the identification of habitat areas that will support achievement of MLPA goals. Candidate benefiting species include depleted[3], depressed[4], or overfished[5] species that meet one or more of the following conditions:

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[3] In its second goal in Section 2853(b), the MLPA refers to the term *depleted* in reference to marine life populations. Although there is no formal definition for this term related to fisheries management, the Department applies this term to five species of abalone, all of which were previously harvested commercially.

[4] Per the Marine Life Management Act, *depressed*, with regard to a marine fishery, means the condition of a fishery for which the best available scientific information, and other relevant information that the Commission or Department possesses or receives, indicates a declining population trend has occurred over a period of time appropriate to that fishery. With regard to fisheries for which management is based on maximum sustainable yield, or in which a natural mortality rate is available, *depressed* means the condition of a fishery that exhibits declining fish population abundance levels below those consistent with maximum sustainable yield.

[5] Per NOAA Fisheries, "any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding." The term *overfished* generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized. The rebuild target is 40% of unfished levels. It should be noted that what constitutes unfished is crucial, as is the quality of the historical data. When habitat is degraded and no longer supports historical population levels and the unfished biomass is calculated on the basis of recent variability in the stock, harvesting 25% of the "unfished" stock can lead towards extirpation.

- They occur in the central coast study region.
- They are taken directly or indirectly in commercial or recreational fisheries.
- They have life history characteristics that make them more conducive to protection by MPAs, such as sedentary behavior, long life spans, slow growth, or associations with habitats that need additional spatial protection. An MPA would be expected to increase the species abundance or spawning biomass if the species is at an abnormally low abundance or abnormally low size frequency (i.e., below the range of natural fluctuations).

A list of species likely to benefit from MPAs can be found in Appendix F of this EIR, including information on life history. Although this list is approximate, it should be noted that there are other species that may benefit or even diminish from the establishment of an MPA. In addition, it should be noted that many species have not yet been assessed for abundance or size frequency, or their full life history requirements are not yet known. Furthermore, many species have not yet had their populations assessed. General information on what is known about the status of harvested species can be found in California's Living Marine Resources: A Status Report (CDFG 2001). In addition, information on groundfish managed by the PFMC can be found at http://www.pcouncil.org/groundfish (CDFG 2005a).

A few of the candidate species potentially benefiting from MPAs in the central coast study region are discussed below.

Invertebrates

Abalone, brown rock, red sea urchin, and Pismo clam, all of which occur within the study region, are preferred prey of the sea otter. Abalone are considered depleted in part of their range. The other species are not considered "depleted"; however, the otter's presence is a major factor in limiting recreational or commercial fisheries for them in this region. It is unlikely that regional objectives, related to the enhancement or recovery of these invertebrate populations by the establishment of additional MPAs, would be achieved. However, MPAs would allow the comparison of the status of these stocks within and outside fished areas and assist in the evaluation of traditional management measures (CDFG 2005a).

Groundfish

There are eight groundfish species (lingcod and seven rockfishes) that NMFS has formally declared to be overfished, thereby triggering stringent rebuilding efforts under the MSFCMA. Seven of the eight species occur within the central coast study region, including lingcod, bocaccio, canary rockfish, cowcod, darkblotched rockfish, widow rockfish, and yelloweye rockfish (CDFG 2005a). The eighth, Pacific Ocean perch, is uncommon within the study region.

Based on their life history traits and habitat requirements, the first seven species would benefit from the establishment of MPAs, including MPAs in which the primary goal is not related to fishery management within the central coast study region, if appropriate habitats are protected. It should be noted that as a result of fishery closures recommended by the PFMC and implemented by NMFS, overfishing of the above-mentioned groundfish species is no longer occurring. However, the rebuilding plans for these species (except for lingcod, which is considered to be recovered) will take considerable time (i.e., decades) to achieve success. Until then, the rockfish species continue to be considered in an overfished status. In addition, thornyheads are considered by NMFS to be in the “precautionary zone”—a population level that is below the level capable of producing maximum sustainable yield (CDFG 2005a).

Copper rockfish is considered a potential candidate for local depletion. This species occurs within the study region and is a good candidate for receiving additional protection through the establishment of MPAs. Scientists have also raised concerns about several rockfish species in the Monterey Bay area, based on the reduced mean size of fish in sport landings. From 1960 to 1994, the mean size of the top 10 rockfish species caught recreationally in this area declined by factors ranging from 1% to 27%. Those species include blue, canary, greenspotted, greenstriped, olive, bocaccio, chilipepper, yellowtail, and widow; the latter four species each declined by more than 10% in mean size, and two of these are considered overfished (CDFG 2005a).

Strong recruitment of a single-year class may lower the mean size of harvested fish when that class reaches a harvestable size, and a periodic reduction in mean length is a natural phenomenon. However, mean length becomes a concern when it remains depressed and is coupled with an overall decline in abundance. Reduction of mean sizes in the population can have negative effects on reproductive output and possibly on genetic variability. The concern over shelf rockfish species is evidenced by the establishment of significant recreational and commercial fishery closures beginning in 2002 in the form of the RCAs. Within the central coast study region, the RCAs cover approximately 4% of the area with full-time closures. In addition, the Nearshore Fishery Management Plan (NFMP) has identified MPAs as a management strategy and deferred implementation to the MLPA of any new MPAs for meeting NFMP objectives. The 19 species covered by the NFMP are black rockfish, black-and-yellow rockfish, blue rockfish, brown rockfish, cabezon, calico rockfish, California scorpionfish (not found within study region), California sheephead, China rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp greenling, rock greenling, kelp rockfish, monkeyface eel, olive rockfish, quillback rockfish, and treefish (CDFG 2005a).

Areas of importance for demersal[6] fish density and diversity (top 20th percentile), as mapped by the NOAA Biogeographic Assessment of the MBNMS, are shown on Figures 6.1-2a and 6.1-2b. Identification of these fish diversity and density hotspots was based on data from CDFG hook-and-line recreational data (for the 5 to 200 m range) and NMFS shelf, slope, and midwater trawl data (CDFG 2005a).

[6] *Demersal* means bottom-dwelling.

6.1.2. Regulatory Framework

Coastal and open water jurisdictions, resource-based agencies, and commissions are described in Chapter 1. Regulations pertaining to species and habitat protection and management are described further below.

6.1.2.1. Federal Policies

Federal Endangered Species Act

The ESA protects fish and wildlife species, and their habitats, that have been identified by the USFWS or NOAA Fisheries as threatened or endangered. *Endangered* refers to species, subspecies, or distinct population segments that are in danger of extinction through all or a significant portion of their range. *Threatened* refers to species, subspecies, or distinct population segments that are likely to become endangered in the near future. The ESA is administered by the USFWS and NOAA Fisheries. In general, NOAA Fisheries is responsible for protection of ESA-listed marine species and anadromous fishes, whereas listed, proposed, and candidate wildlife and plant species are under USFWS jurisdiction.

Marine Mammal Protection Act

All marine mammals are protected under the MMPA. It prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, as well as the importing of marine mammals and marine mammal products into the U.S.

Migratory Bird Treaty Act

The MBTA (16 United States Code [USC] Section 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and former Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 10, 21). Most actions that result in taking or permanent or temporary possession of a protected species constitute violations of the MBTA. Examples of permitted actions that do not violate the MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. The USFWS is responsible for overseeing compliance with the MBTA, and the U.S. Department of Agriculture's Animal Damage Control Officer makes recommendations on related animal protection issues. Take under the MBTA is also a state law violation (FGC 3513).

Federal Sustainable Fisheries Act

The Sustainable Fisheries Act (Public Law 104-297) of 1996 reauthorized and amended the Magnuson Fishery Conservation and Management Act (now Magnuson-Stevens Fishery Conservation and Management Act [Magnuson-Stevens Act]), the latter of which was initially enacted in 1976 to define fisheries jurisdiction within federal waters and create the NOAA structure for federal fisheries management. The revisions provided in the 1996 law brought major changes to requirements for preventing overfishing and revitalizing depleted fisheries, mostly through the scientific management and reporting conducted via fisheries management reports.

Federal Pacific Coast Groundfish Regulations

Federal jurisdiction over Pacific coast groundfish was established by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 and implemented in 1982 with the adoption of the initial Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2004). The FMP, which was most recently amended in 2005 , seeks to provide a balance between conservation, prevention of overfishing, and maximization of the fisheries' resource. The plan covers 88 species of fish, including sharks, roundfish, groundfish, and flatfish; sets limits on harvest levels; establishes policies for periodic review and revision of regulatory requirements and limitations; and outlines programs for rebuilding depleted stocks. Management considerations such as licensing and permitting, size and bag limits, and net restrictions are outlined for commercial and recreational activities.

Essential Fish Habitat

The Magnuson-Stevens Act defines essential fish habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NOAA Fisheries guidelines state that "adverse effects from fishing may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem."

The coastal pelagic EFH includes habitats for five species: Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel, and market squid. Technically, this habitat extends from the coast to the edge of the EEZ between the U.S. borders with Canada and Mexico.

The Pacific Coast groundfish EFH includes habitats for 83 species of groundfish. EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish EFH for each of the 83 species and their life stages result in more than 400 EFH identifications. When these EFHs are taken together, the groundfish EFH includes all waters from the mean higher high water line and the upriver extent of saltwater intrusion in river mouths, along the coast of Washington, Oregon, and California seaward to the boundary of the

EEZ. The seven “composite” EFH identifications are as follows: estuarine, rocky shelf, non–rocky shelf, canyon, continental slope/basin, neritic zone, and the oceanic zone). The life history and habitat needs for the 83 species managed under the groundfish FMP are described in the EFH appendix to Amendment 11 (PFMC 1998).

Pacific salmon EFH includes habitat for three species of Pacific salmon: Chinook, coho, and Puget Sound pink salmon. Coho and Chinook salmon EFH occurs in the central coast study region. The EFH for these salmon includes the waters and substrate necessary for salmon production to support a long-term sustainable salmon fishery. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters to the full extent of the EEZ. The Pacific salmon EFH also includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon.

Habitat areas of particular concern (HAPCs) are described in the regulations as subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. These include estuaries, canopy kelp, seagrass, and rocky reef habitats. Although designated HAPCs are not afforded additional protection under the Magnuson-Stevens Act**,** potential impacts on HAPCs are considered in consultation regarding federal projects that may affect designated HAPCs.

EFH Closures Areas

In June 2006, EFH protection measures were amended to include implementation of discrete area closures for specific gear types. Closure areas were identified by the PFMC with the intention of minimizing adverse effects of fishing on groundfish EFH, and included EFH, HAPC, and EFH Conservation Areas. Of these, only the EFH Conservation Areas are closed to specific types of fishing.

Non-Trawl and Trawl Rockfish Conservation Areas

The coastwide commercial RCA was established in January 2003 by NOAA Fisheries to protect and assist in rebuilding of stocks of lingcod and seven species of rockfishes. The RCA in the central coast study region is categorized by four gear types: trawl limited entry, trawl open access, fixed gear limited entry, and non-trawl open access (the latter two are considered non-trawl). Trawl and non-trawl RCAs vary seasonally and regionally. Effective protection equivalent to that of an MPA occurs where the RCA is closed year-round to particular gear types.

6.1.2.2. State Policies

California Endangered Species Act

Under the CESA, the Department has jurisdiction over threatened or endangered species that are formally listed by the state. The CESA is similar to the ESA both in process and substance, with the intention of providing additional protection to threatened and endangered species in California. The CESA does not supersede the ESA, but operates in conjunction with it. Species may be listed as threatened or endangered under both acts, in which case the provisions of both state and federal laws apply, or under only one act. Under the ESA, habitat is protected, while under CESA it is not. Also, independent of the CESA, state law has established “protected” status for certain statutorily identified birds (California Fish and Game Code [FGC] 3511), mammals (FGC 4700), reptiles and amphibians (FGC 5050), and fish (FGC 5515).

California Marine Life Management Act

The Marine Life Management Act (Assembly Bill 1241; Statutes of 1998, Chapter 1052) was enacted to promote sustainable marine fisheries, primarily through FMPs based on the best readily available scientific and other relevant information. FMPs are prepared by the Department and submitted with implementing regulations for review and approval by the Commission. FMPs have been prepared for white seabass, nearshore fisheries, and market squid.

Recreational Groundfish Full-Time Closure Areas

Current California recreational fishing regulations for popular groundfishes limit catch to within particular depth zones (depth specified regionally). The depth zones vary but are consistent within a management area. Within the central coast study region, there are two management areas: Monterey South-Central (37°11’N latitude to 36°N latitude) and Morro Bay South-Central (36°N latitude to 34°27’N latitude). These regulations leave certain areas within state waters restricted from fishing year-round.

California Fish and Game Commission Fishing Regulations

The Department produces pamphlets that summarize sport and commercial fishing statutes and regulations, and updates them annually. The pamphlets include catch limits for specific species, size limits, seasonal closures, area closures (including a list of all state MPAs), and depth restrictions. Regulations for groundfish species—including rockfish, cabezon, sheephead, scorpionfish, and lingcod—are listed for each of five groundfish management areas along the coast, including the two mentioned previously for the study region.

6.1.3. Impact Analysis

6.1.3.1. Methodology

This impact analysis is based on available data and information compiled in the Regional Profile of the Central Coast Study Region (Pigeon Point to Point Conception California) (CDFG 2005a) and master plan framework prepared by the Science Advisory Team (CDFG 2005a), as well as a review of pertinent literature and personal communications on other existing MPAs.

6.1.3.2. Criteria for Determining Significance

The State CEQA Guidelines and professional judgement were used to determine whether the Proposed Project would have a significant impact on biological resources. The Proposed Project would have a significant impact if it would:

- have a substantial adverse effect, either directly or through habitat modification, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the Department or USFWS;

- have a substantial adverse effect on federally protected wetlands, as defined by Clean Water Act Section 404 (including marsh, vernal pool, and coastal wetlands) through direct removal, filling, hydrological interruption, or other means;

- interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

- conflict with any local policies or ordinances protecting biological resources; or

- conflict with the provisions of an adopted , natural communities conservation plan, or other approved local, regional, or state habitat conservation plan.

<u>Additional Impact Assessment Considerations</u>

One of the key issues identified by many participants involved in designation of MPAs is the displacement of fishing activities from protected to unprotected areas and the negative effects that may result from redirected fishing effort on fish populations outside of protected areas. The key question regarding redirected fishing effort is whether the expected increase in export of fish in all life stages from MPAs can compensate for the increased fishing pressure in areas outside MPAs. If export does outpace extraction, fishery yields should show a net increase or remain the same despite the displaced effort.

If one assumes the same amount of fishing pressure in the project region before and after an MPA is established, then the amount of fishing outside the MPA will increase in proportion to the size of the MPA for the species restrictions applied to the MPA. That is, the fishing that used to occur inside what is now an MPA will be distributed outside the MPA in the remaining, non-protected area in proportion to the size of the MPA. This can be simply calculated. If R is the fraction of area in MPAs within the study region, then fishing intensity outside the MPAs will increase by a factor $1/(1–R)$. For example, if 15% of the habitat is closed to fishing in MPAs, the intensity of fishing outside would increase by $1/(1–0.15) = 1.18$. That is, if the same number of users were fishing the same number of hours in the remaining 85% of the habitat, the fishing intensity would be 18% higher than before. In this example, in the short term, displacement would increase mortality rates outside the MPAs probably by 18%. However, if MPAs enhance populations beyond their boundary through movement of adults or young, these increases could be offset or eliminated by MPA benefits. The increased production within the MPA boundaries necessary to counter the increased fishing intensity outside can be calculated as well. The formula is $1+[1/(1–R)]$. For the example above, the result equals 2.18. This means that production inside the boundary of the MPAs must increase by a factor of 2.18 to just balance the added losses outside the MPAs. A higher level of production would be needed to help rebuild depleted populations, one of the goals of the MPLA. The relative time for the Proposed Project or alternatives to achieve the goals of the MLPA must also be considered in the impact analysis.

6.1.3.3. Environmental Impacts

Neither the Proposed Project nor alternatives would have a significant impact on federally protected wetlands; interfere substantially with the movement of any native resident or migratory fish or wildlife species or corridors; impede the use of native wildlife nursery sites; conflict with local policies or ordinances protecting biological resources; or conflict with the provisions of an adopted habitat conservation plan or natural communities conservation plan. Therefore, these criteria are not considered further in the impact analysis.

Impact BIO-1: Adverse Impacts on Marine Species Populations and Habitats Outside MPAs from Displacement and Congestion of Fishing Effort Outside MPAs

Proposed Project: Less than Significant

Fishing effort may become concentrated around MPAs for several reasons. The possibility exists that establishment of MPAs, particularly SMRs and SMCAs that restrict bottom fishing, will displace and concentrate existing fishing effort into other state waters along the central California coast. Alternately, fishing effort may be attracted to the edges of established MPAs to benefit from potential increases in catch or catch per unit effort. It is suggested that either of these types of congestion could lead to marine species population decline and habitat degradation impacts outside MPA boundaries. This effect has not been documented in other areas.

The comprehensive reviews of no-take reserve impacts suggest that production increases inside reserves worldwide show a fourfold increase (a factor of 4.00) in average production. This is much larger than the increase of production needed within the reserve, a factor of 2.18 (about 118%), cited in the above example. These empirical data suggest that enhanced production within reserves can more than compensate for the effects of fishing effort displacement outside of reserve areas as high as 50% of the region. These conclusions are supported by empirical data outside existing reserves. There is increasing evidence that models accurately predict the direction of change in fisheries yields associated with marine reserves. As the number and biomass of individuals increase within reserves, individuals of many species will move out of reserves, enhancing stocks in fished areas through spillover of adults and export of larvae. Biomass of five commercially important species doubled in fishing areas adjacent to the Soufriere Marine Management Areas off Saint Lucia within a few years after reserve establishment (Roberts et al., 2001). Scientists documented the movement of four species of sport fishes from the Merritt Island National Wildlife Refuge to adjacent fished areas. The movement of these fishes from the refuge to adjacent areas has been identified as the primary factor responsible for the increase in numbers of catches of world-record fishes in the vicinity of Merritt Island (Roberts et al., 2001). Since 1985, all new Florida records for black drum and most records for red drum have been won for fish caught adjacent to the Merritt Island refuge (Stevens and Sulak 2001). Four years after closed areas were established on the Georges Bank, scallop (*Placopecten magellanicus*) biomass increased 14-fold within the closed areas (Muraski 2000). Satellite tracking shows that scallop fisheries are now concentrated near closed areas, and total landings are 150% of 1994 levels. A 110% enhancement of catch per unit effort in fishing grounds close to the Mombasa Marine National Park in Kenya was found (McClanahan and Kaunda-Arara 1996). Also, the highest catches and catch per unit effort occurred inside the Barbados Marine Reserve, and catches increased outside the reserve along a gradient approaching the boundary from both the north and the south (Ratkin and Kramer 1996) (above paragraph from CDFG 2002).

Data from existing reserves show that in spite of the increased fishing effort around reserves, the abundance of targeted species is highest in reserves and declines in proportion to distance from reserves. If the concentrated fishing effort around reserves caused local declines, the abundance of targeted species would be high within and distant from reserves but low at the edges of reserves. However, numerous reserves have been studied worldwide and this pattern of decline has not been detected (e.g., Roberts and Hawkins 2000**).** Therefore, the positive effects of reserves on abundance appear to counteract potential negative effects of displacement or concentration of fishing activity around reserves.

Changes in fish populations that would encourage concentrated fishing activity near the boundaries of MPAs will not occur immediately. It will take some years of protection before fish species within the MPA will have time to recruit successful year classes, reach catchable size, and increase in number such that fish emigrate from the MPA. It is not expected that fishermen will spend more of their time in these areas until there is a noticeable difference in the size and abundance of fish in these areas. However, an expectation of more catchable fish near MPA boundaries may encourage a transient spike in fishing activities in these areas. Therefore, there is a slight chance for some adverse effects. This slight potential for short-term overfishing at MPA boundaries would be outweighed by the positive benefits of MPAs in the long term.

An additional consideration is redirected fishing effort to areas other than MPA boundaries for those fishermen whose favorite fishing areas are now included in the MPAs. As for the MPA boundary fishing question, the MPAs would likely improve the overall fishable biomass in the region, and any short-term reductions in fish populations in unprotected areas would be outweighed by the longer-term regional trend.

If concentrated fishing at the edges of MPAs reduces habitat quality, a corresponding decrease in abundance and diversity of species adjacent to MPAs would be expected. As indicated above, this trend is not observed at the edges of reserves from previous studies worldwide, which consistently support higher abundance and diversity of fishes and invertebrates than other sites distant from reserves. No published data on existing MPAs have shown negative environmental impacts. Therefore, displacement-related impacts of the Proposed Project resulting in adverse impacts to marine species populations and habitats would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Alternative 1: Less than Significant

Alternative 1 would result in a smaller area of MPAs than the Proposed Project, (14.4 % of the region vs. 17.3%) and have less coverage by SMRs (5.1% vs. 8.1%). This alternative has the least potential of the MPA network component packages considered to result in displacement of fishing activities. Any potential displacement effects on biological resources associated with Alternative 1 would be similar but less than those described for the Proposed Project. Therefore, impacts on biological resources from Alternative 1 would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Alternative 2: Less than Significant

Alternative 2 would result in a larger area of MPAs than the Proposed Project, (19.3% vs. 17.3% of the region) and have more coverage by SMRs (12.8% vs. 8.6%). This alternative has slightly more potential to result in the displacement of fishing activities. However, such effects are not anticipated to be substantially greater or different than the Proposed Project as discussed above. Therefore, displacement-related impacts resulting from Alternative 2 would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Beneficial Impacts to Biological Resources

While CEQA generally considers the potential negative or adverse impacts on the physical environment, a discussion of the beneficial impacts of the Proposed Project and alternatives is provided to evaluate one of those goals of the MLPA related to the protection of habitat and the resultant benefits.

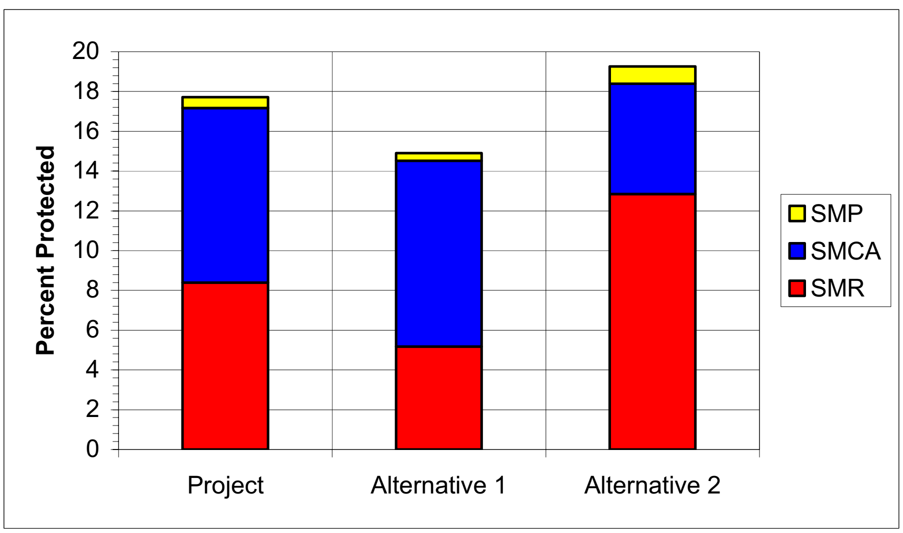
Impact BIO-2: Impacts on Marine Species Populations and Habitats Inside MPAs

Habitat Protection

In Chart 6.1-1, the amount of protection for the Proposed Project and alternatives is shown by the level of protection (SMR, SMCAs, and SMP). The amounts of each type of habitat in the region to be protected under the Proposed Project and alternatives for all MPAs combined are shown in Chart 6.1-2.

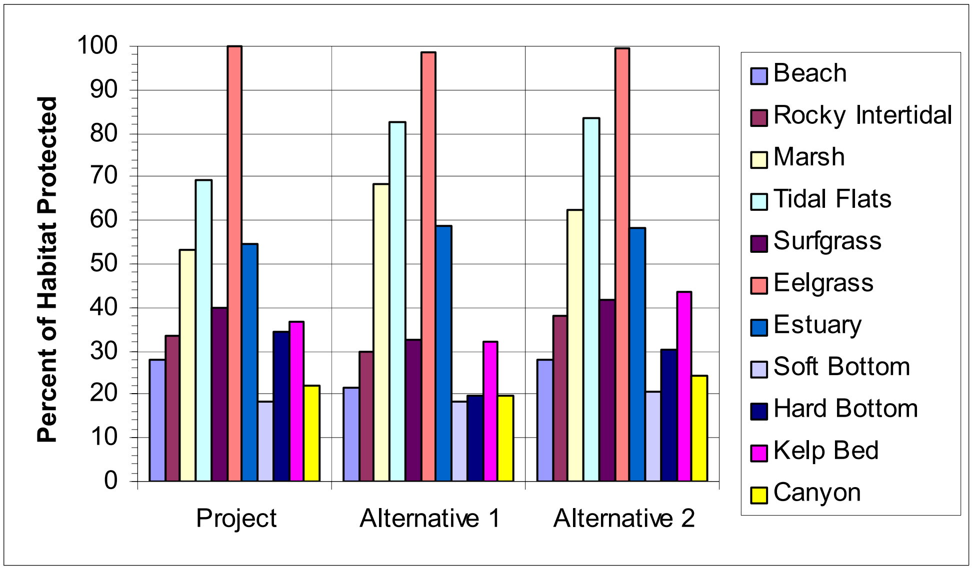
Alternative 1 would result in the protection, to some degree, of at least 20% of all habitat types except for hard bottom habitats (19.6%) and soft bottom habitats (18.5%) (Charts 6.1-1 and 6.1-2). The Proposed Project and Alternative 2 protect, to some degree, at least 20% of all habitats types in the central coast study region (Charts 6.1-1 and 6.1-2). Alternative 2 protects more habitat than the Proposed Project for most habitat types: beach (29% vs. 21%), rocky intertidal (38% vs. 27%), marsh (62% vs. 51%), tidal flats (84% vs. 70%), surf grass (42% vs. 31%), estuary (58% vs. 55%), kelp bed (42% vs. 34%), and soft bottom (24% vs. 14%). The levels of protection are about the same for eelgrass habitats under the Proposed Project and Alternative 2 (99% to 100%), while the Proposed Project protects slightly less of the canyon habitat (24% vs. 21%).

Chart 6.1-1. Comparison of Proposed Project and Alternatives by Percent of Study Region and Level of Protection



Notes: SMP = State Marine Park, SMR = State Marine Reserve, SMCA = State Marine Conservation Area.

Chart 6.1-2. Percentage of Each Habitat Type in Central Coast Region Protected under the Proposed Project and Alternatives 1 and 2



Note: Within each of the **alternatives** displayed on the x-axis, the colors from left to right are in the same order as displayed from top to bottom in the accompanying key.

The number of MPAs in each category and their areas are shown in Table 6.1-2 The category with the highest level of protection, the SMR, differs among the three MPA alternatives. In the Proposed Project, 8.6% of the study region is in SMRs; 5.1% in Alternative 1, and 12.8% in Alternative 2.

Table 6.1-2. Number and Area of MPAs by Type under Proposed Project and Alternatives 1 and 2

Package	State Marine Park		State Marine Conservation Area		State Marine Reserve		Total	
	Number	Square Miles	Number	Square Miles	Number	Square Miles	Number	Square Miles
Proposed Project	2	6.35	11	98.62	16	98.89	**29**	**203.86**
Alternative 1	1	4.4	13	107.4	15	59.6	**29**	**171.4**
Alternative 2	1	9.8	8	63.9	21	147.7	**30**	**221.4**

Note: The southern portion of the proposed Morro Bay SMRMA was included with the SMRs for the Proposed Project. The remainder of the proposed Morro Bay SMRMA was included with the SMCAs for the Proposed Project. The proposed Morro Bay South SMRMA was included with the SMRs for both Alternatives 1 and 2.

Source: CDFG 2006

In Chart 6.1-1, it can be seen that there are differences in the percentage of total area that is protected within MPAs in the various packages, ranging from about 14.4% in Alternative 1 to 19.3% in Alternative 2. The most prominent difference between the Proposed Project and Alternative 2, is in the percentage of area within SMRs, the highest level of protection.

Overlap with Other Fishery Management Regulations

An MPA network that partially overlaps other fisheries management protection provides the greatest benefit to marine resources by expanding the extent of habitat and species protections, while serving to reduce potential impacts to fishermen because the area within the overlap is already closed to some forms of fishing. Table 6.1-3 considers the Proposed Project and alternatives in light of existing fishery management regulations, particularly trawl and non-trawl RCAs, recreational year-round groundfish closures, and proposed EFH trawl closure areas along the California coast.

Table 6.1-3. Number of MPAs Overlapping with Other Fishery Management Regulations

Package	Rockfish Conservation Area			EFH Trawl Closure
	Non-Trawl RCA	Trawl RCA	Recreational Year-Round RCA	
Proposed Project				
Complete Overlap[a]	5	–	7	5
Partial Overlap[b]	8	5	9	3
No Overlap	**16**	**24**	**13**	**21**
Alternative 1				
Complete Overlap	–	–	6	4
Partial Overlap	15	5	9	2
No Overlap	**14**	**24**	**14**	**23**
Alternative 2				
Complete Overlap	1	–	6	6
Partial Overlap	13	5	7	1
No Overlap	**16**	**25**	**17**	**23**

[a] Overlapping coverage of 80% to 100%.

[b] Overlapping coverage up to 80%.

Note: Table based on 2005 regulations which are subject to change annually.

As illustrated in Table 6.1-3, the Proposed Project and alternatives provide a substantial resource protection in addition to that provided by the groundfish closures. Alternative 2 has the highest total numbers of MPAs with no overlapping regulatory protections, while the Proposed Project and Alternative 1 both have slightly fewer MPAs with no overlap. Conversely, all of the alternatives show some degree of overlap with the groundfish closures, which serves to reduce some the potential negative impact to fishermen from the implementation of the MPAs. Alternative 2 has the lowest number of MPAs with a combined full or partial overlap. The Proposed Project and Alternative 1 are fairly similar in their combined full and partial overlap, but the Proposed Project would result in substantially more fully overlapping MPAs.

It should be noted that other ongoing fisheries management processes recently have reduced the total fishing effort in the study region. Examples include the Nearshore Fishery and Market Squid Fishery Management Plans (CDFG 2002b, 2004a), which recently established restricted access programs, and the spot prawn trap fishery, which established a restricted access program in 2002. The Nearshore Fishery Management Plan has implemented harvest reductions in the form of shortened fishing seasons for rockfish, cabezon, and kelp greenling, as well as reduced recreational bag limits and commercial trip limits. The net effect of reducing effort further reduces the possibility for congestion outside MPAs.

Based on the above information and discussion, taking into account the changes that are likely to occur under the Proposed Project and its alternatives, the following conclusions can be made:

Proposed Project: Beneficial Impact

There will be substantial biological resource benefits because of the increased habitat protection that would occur under the proposed MPA network component. There also is likely enough area protected within proposed MPAs to provide some benefits to some overfished rockfish populations that depend on these habitat types for some part of their life history, and to prevent further degradation of marine habitats that are vital to marine ecosystems of the central California study region.

Mitigation: No mitigation is required.

Alternative 1: Beneficial Impact

Benefits to biological resources resulting from Alternative 1 would be close to but less than those of the Proposed Project as there would be less habitat preserved to benefit certain populations of marine species that depend on these habitat types for some part of their life history and to prevent further degradation of marine habitats that are vital to marine ecosystems of the central California study region.

Mitigation: No mitigation is required.

Alternative 2: Beneficial Impact

Benefits to biological resources resulting from Alternative 2 would be somewhat greater than those of the Proposed Project , as there would be slightly more habitat preserved to benefit populations of marine species that depend on these habitat types for some part of their life history and to prevent further degradation of marine habitats that are vital to marine ecosystems of the central California study region.

Mitigation: No mitigation is required.

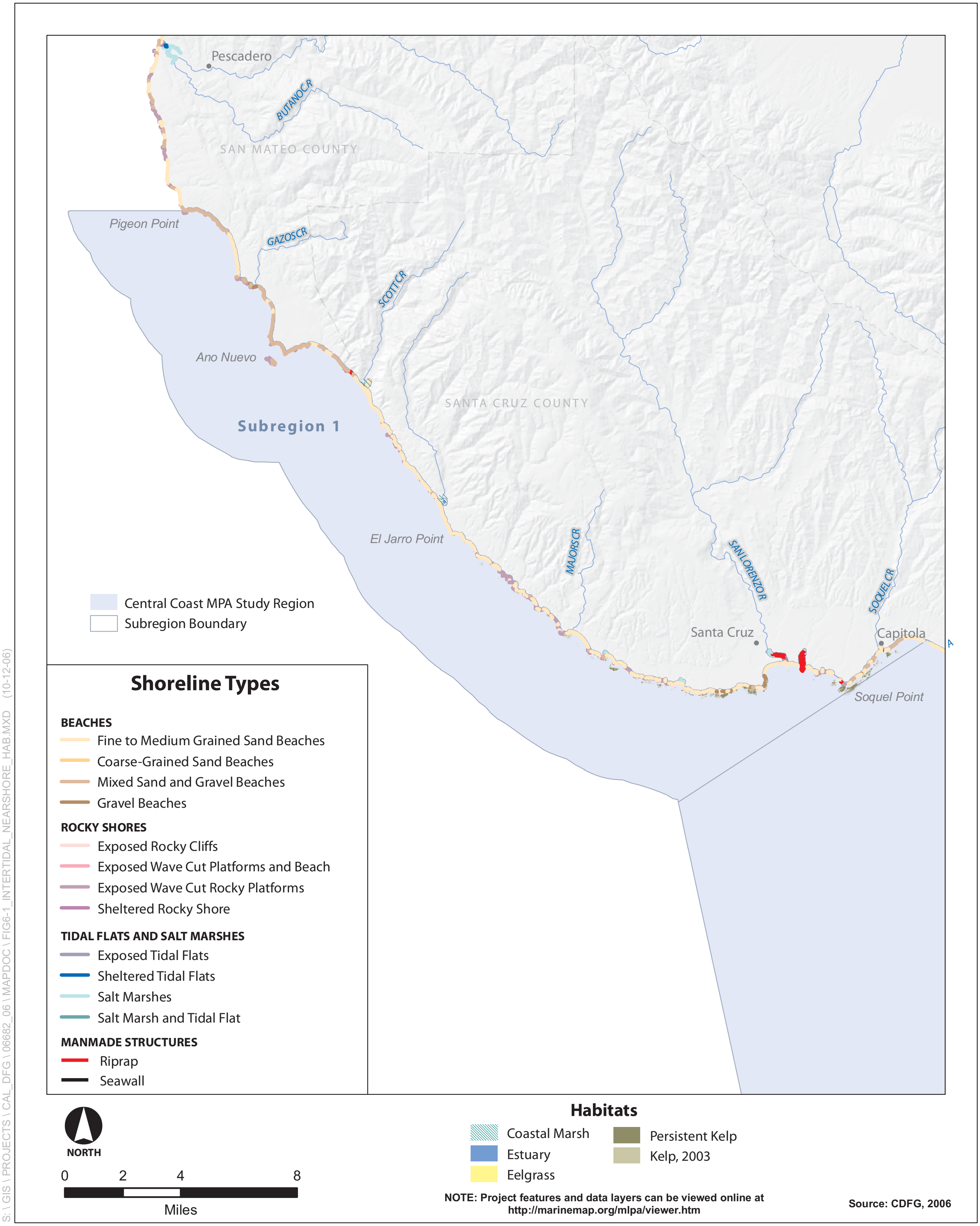


Figure 6.1-1a

Intertidal and Nearshore Habitats

Subregion 1: Pigeon Point to Capitola

Jones & Stokes

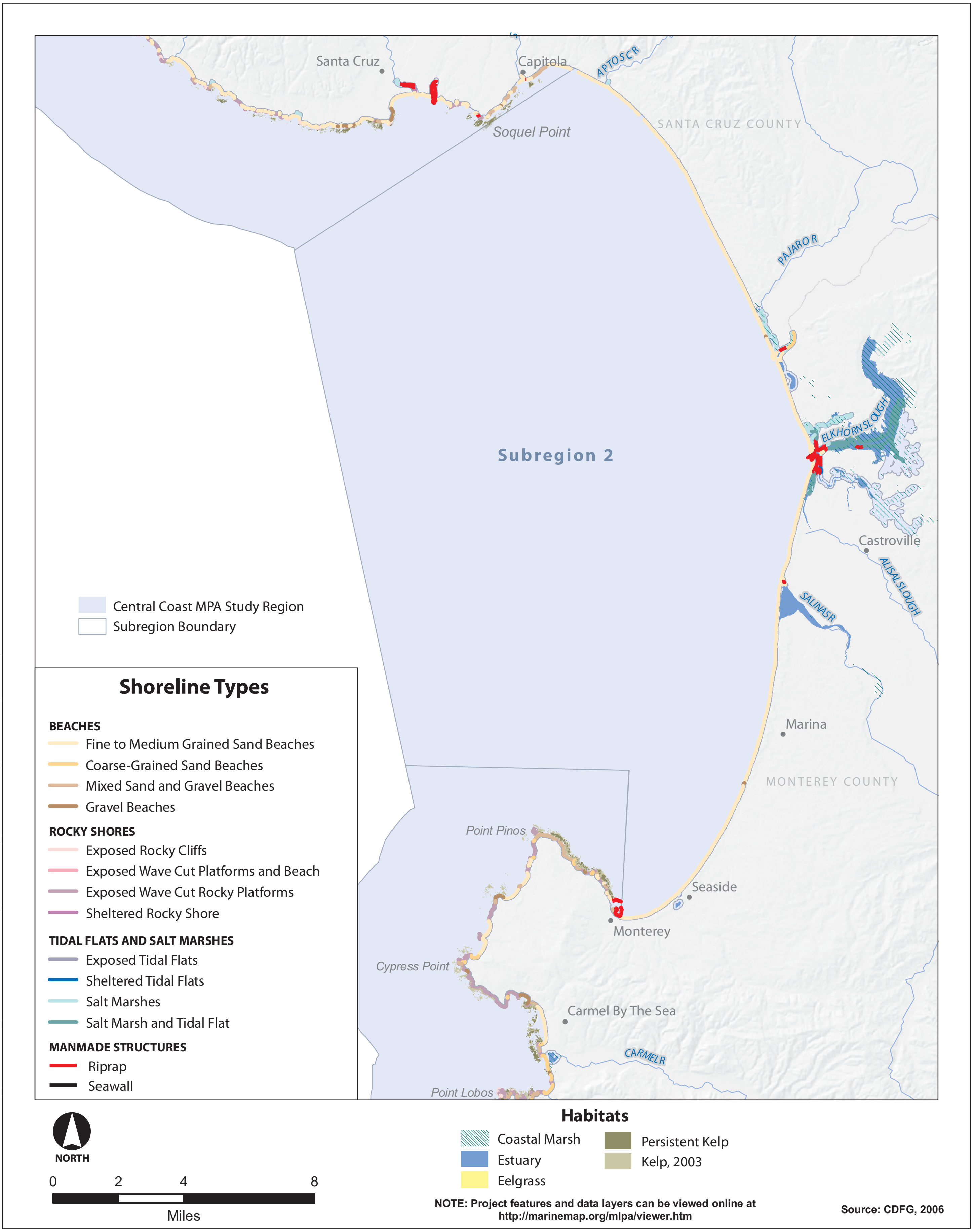


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Figure 6.1-1b

Intertidal and Nearshore Habitats

Subregion 2: Capitola to Monterey Breakwater

Jones & Stokes

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Figure 6.1-1c

Intertidal and Nearshore Habitats

Subregion 3: Monterey Breakwater to Point Sur

Jones & Stokes

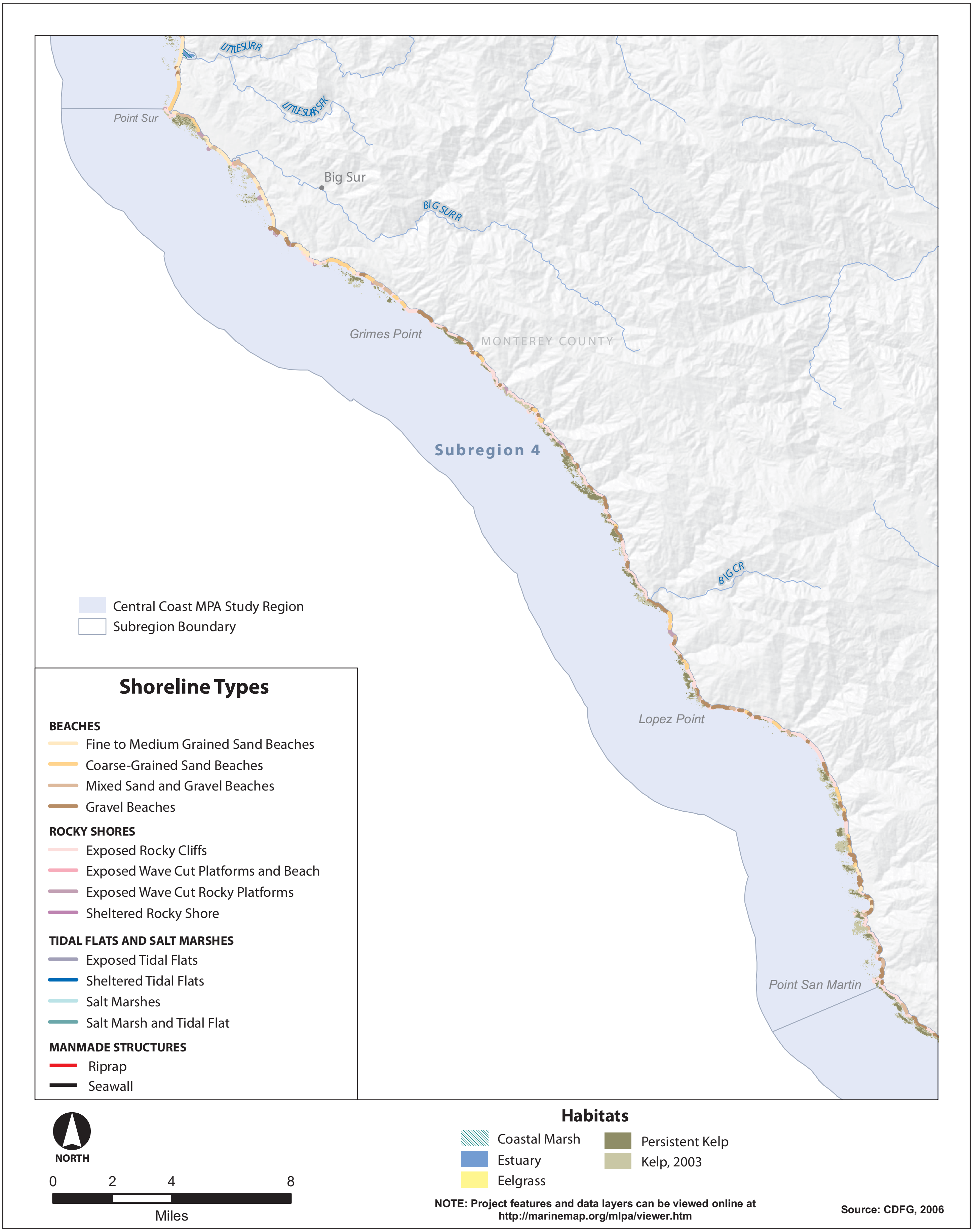

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Figure 6.1-1d

Intertidal and Nearshore Habitats

Subregion 4: Point Sur to San Martin

Jones & Stokes

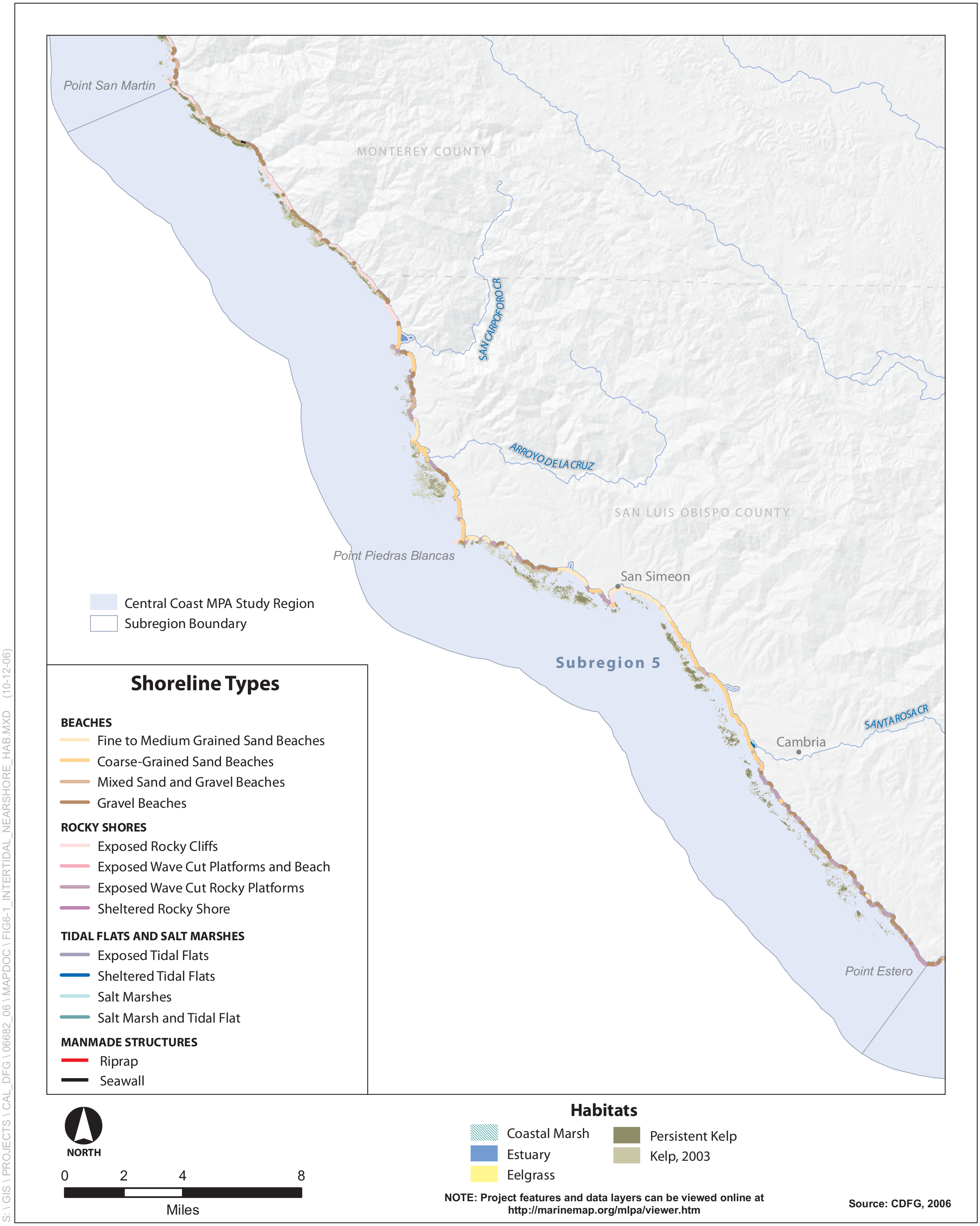

Figure 6.1-1e

Intertidal and Nearshore Habitats

Subregion 5: San Martin to Point Estero

Jones & Stokes

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Figure 6.1-1f

Intertidal and Nearshore Habitats

Subregion 6: Point Estero to Santa Maria River

Jones & Stokes

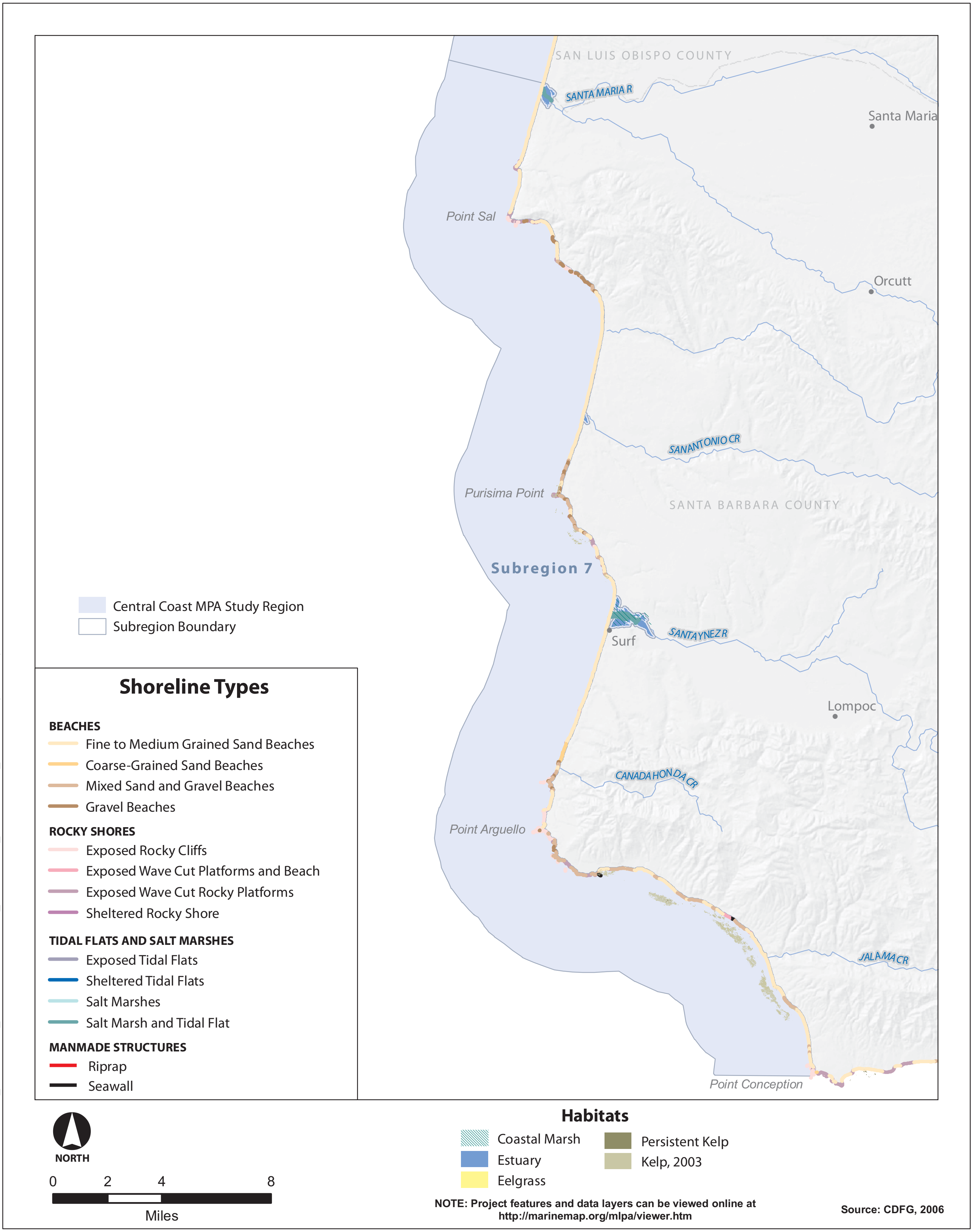

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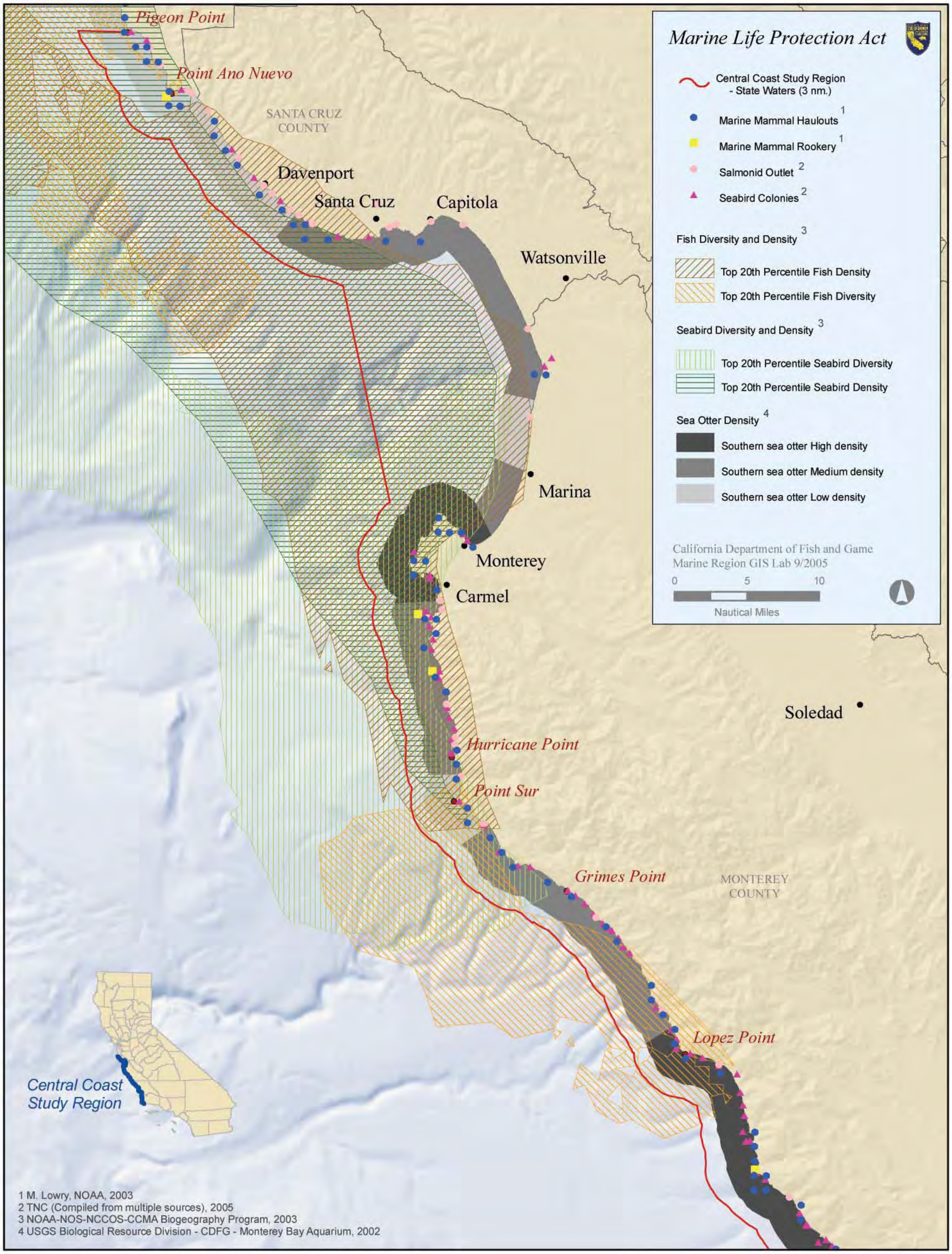
Figure 6.1-1g

Intertidal and Nearshore Habitats

Subregion 7: Santa Maria River to Point Conception

Jones & Stokes



06682.06 EIR (9/06)

Source: CDFG, 2006 **Note:** Project features and data layers can be viewed in greater detail online at http:/marinemap.org/mlpa/viewer.htm

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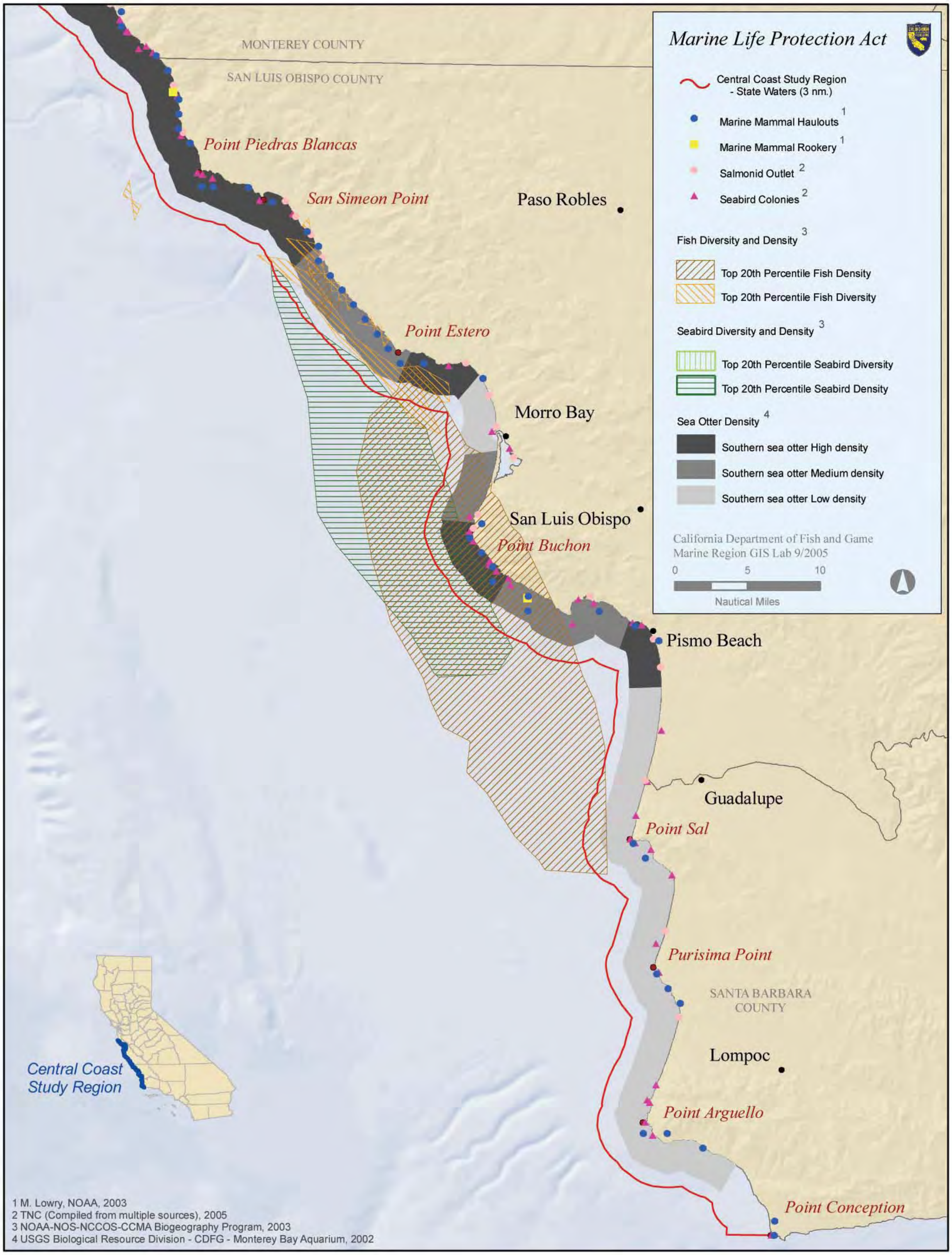
Figure 6.1-2a
Distribution, Density, and Diversity For Selected Species Groups — Northern Study Region



06682.06 EIR (9/06)

Source: CDFG, 2006

Note: Project features and data layers can be viewed in greater detail online at http:/marinemap.org/mlpa/viewer.htm

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Figure 6.1-2b
Distribution, Density, and Diversity For Selected Species Groups — Southern Study Region